I-7188XBD-CAN/µPAC-7186EXD-CAN

User Manual

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Tables of Content

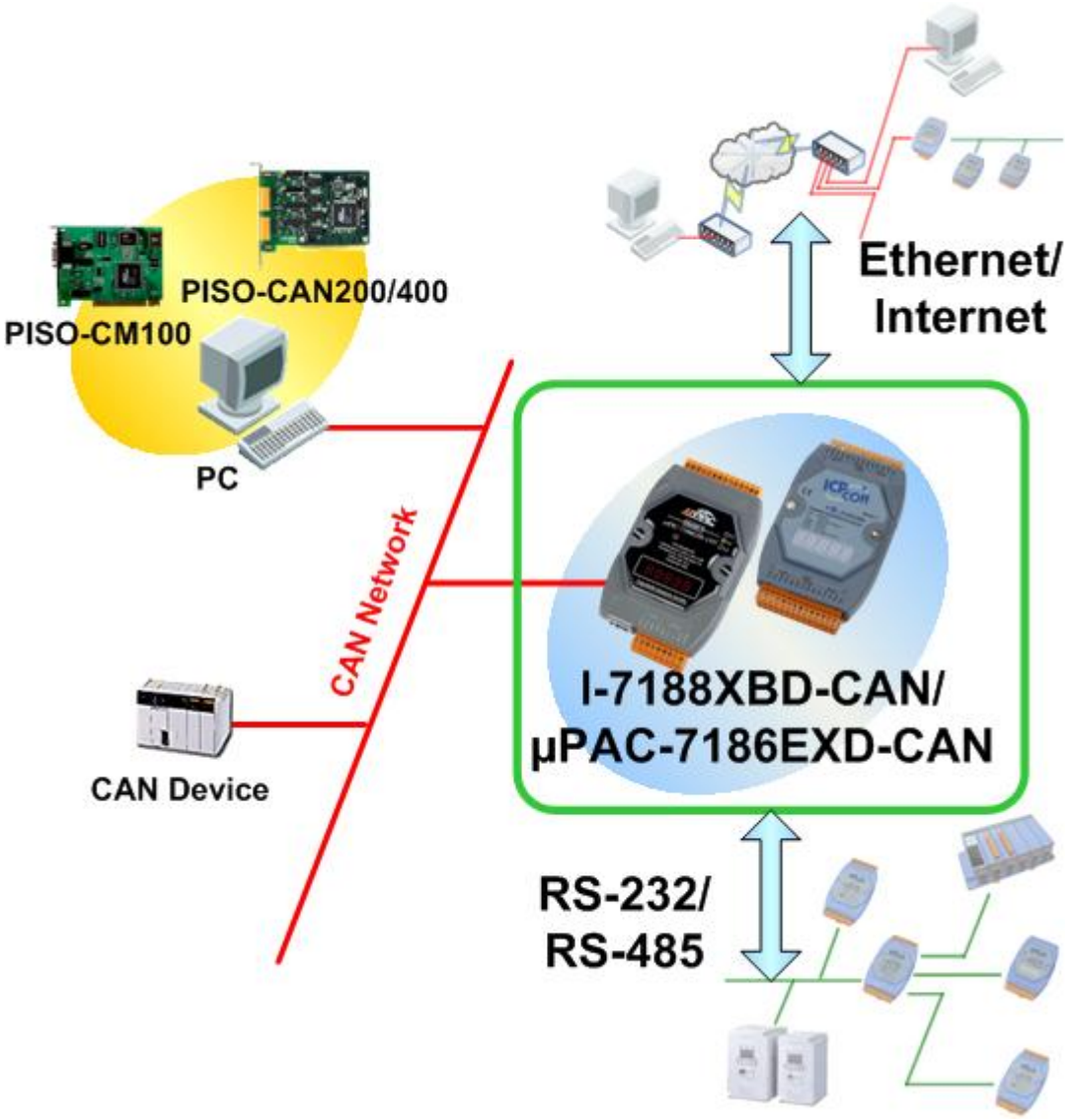
1 Introduction 4
1.1 Overview 4
1.2 Hardware Features 6
1.3 Hardware Specifications 7
2 Hardware Configuration 9
2.1 I-7188XBD-CAN Hardware Structure 9
2.2 µPAC-7186EXD-CAN Hardware Structure 10
2.3 CAN Network Wire Connection 11
2.4 Terminal Resistor Jumper Selection 13
2.5 Wiring Diagram For Different Application 14
2.5.1 Program download 14
2.5.2 General application 14
2.5.3 I-7188XBD-CAN DI & DO channel wiring diagram 16
3 XC100 Library 17
3.1 Library Function Definition and Description 19
3.1.1 CAN_Reset 20
3.1.2 XC100Init 21
3.1.3 SetCANBaud 26
3.1.4 SetCANMask 27
3.1.5 CAN_InstallIrq 28
3.1.6 CAN_RemoveIrq 29
3.1.7 CAN_Resotre 30
3.1.8 CAN_CreateBuffer 31
3.1.9 SendCANMsg 32
3.1.10 GetCANMsg 34
3.1.11 GetStatus 36
3.1.12 ClearStatus 37
3.1.13 L1Off 38
3.1.14 L2Off 39
3.1.15 L3Off 40
3.1.16 L1On 41
3.1.17 L2On 42
3.1.18 L3On 43
3.1.19 UserCANInt 44
3.2 Table of Return Code 46
4 Demo Programs 47

4.1 Program Download Procedure 49

1 Introduction

1.1 Overview

The CAN (Controller Area Network) is a serial communication bus especially suited to interconnect smart devices to build smart systems or sub-system. It efficiently supports distributed real-time control with a very high level of security. In CAN networks, there is no addressing of subscribers or stations in the conventional sense, but instead prioritized messages are transmitted. As standalone CAN controller, I-7188XBD-CAN/µPAC-7186EXD-CAN embedded controller represents an economic solution. It consists of one XC100 and one I-7188XBD/µPAC-7186EXD, and provides one CAN communication ports with 5-pin screw terminal connector for the various CAN applications. Besides, I-7188XBD-CAN/µPAC-7186EXD-CAN uses the new Phillips SJA1000T and transceiver 82C250, which supports both CAN 2.0A and 2.0B specific, re-transmission function, bus arbitration and error detection. Because of the features of I-7188XBD and µPAC-7186EXD, The I-7188XBD-CAN/ µPAC-7186EXD-CAN can be applied to communicate with several kinds of industrial communication interface, such as RS-232, RS-485 and Ethernet of. Therefore, users can design the wide applications between different communication protocols.


Ethernet/
Internet
PISO-CAN200/400
PISO-CM100
PC
CAN Network
I-7188XBD-CAN/
µPAC-7186EXD-CAN
CAN Device
RS-232/
RS-485

1.2 Hardware Features

- 1000Vdc voltage protection.
- Compatible with CAN specification 2.0 parts A and B.
- Programmable transfer rate up to 1 Mbps.
- Jumper select 120Ω terminator resistor for CAN channel
- Programmable with the XC100 library file.
- Allow to design the behavior of CAN controller
- Multi communication interface
- Support Watchdog mechanism
- Programmable Interrupt service routine and timers
- Programmable by C/C++ language

1.3 Hardware Specifications

System

- CPU: 80186, 80MHz (for µPAC-7186EXD-CAN)
- CPU: 80188, 40MHz (for I-7188XBD-CAN)
- SRAM: 512K bytes
- Build-in Flash Memory, EEPROM, NVSRAM, Real Time Clock
- Built-in Watchdog Timer
- 16-bit Timer

Flash Memory

- 512K bytes
- Minimum erase unit is one sector (64K bytes)
- 100,000 erase/write cycles

EEPROM

- 16K bytes (64 blocks, each block has 256 bytes)
- Data retention >100 years
- 1,000,000 erase/write cycles

Real Time Clock

- Year-2000 compliance
- Second, minute, hour, date of the month
- Month, year, valid up from 1980 to 2079
- NVSRAM: 31 bytes, battery backup, data valid up to 10 years

CAN port

- Philip SJA1000 CAN controller
- Philip 82C250 CAN transceiver
- 1000 voltage protection on CAN side
- 120Ω terminal resister selected by jumper
- 16M Hz clock

COM1

- RS-232 or RS-485 Interface
- RS-232: TXD, RXD, RTS, CTS, GND
- Communication speed: 115200 Max.
- Program download port

COM2

- RS-485: D2+, D2-
- Communication speed: 115200 Max.
- Connect to DCON IO modules

Display

- Programmable 7-segment LEDs
- Programmable 4 LEDs (L1, L2, L3 and round LED)

Digital Input (only for I-7188XBD-CAN)

- 1 DI channel
- Dry Contact: Logical level 0: closed to GND, Logical level 1: open
- Wet contact: Logical level 1:3.5V~30V, Logical level 0: 0~1V

Digital Output (only for I-7188XBD-CAN)

- 1 DO channel
- 100 mA, 30V max.
- Open-collector output

Power Requirement

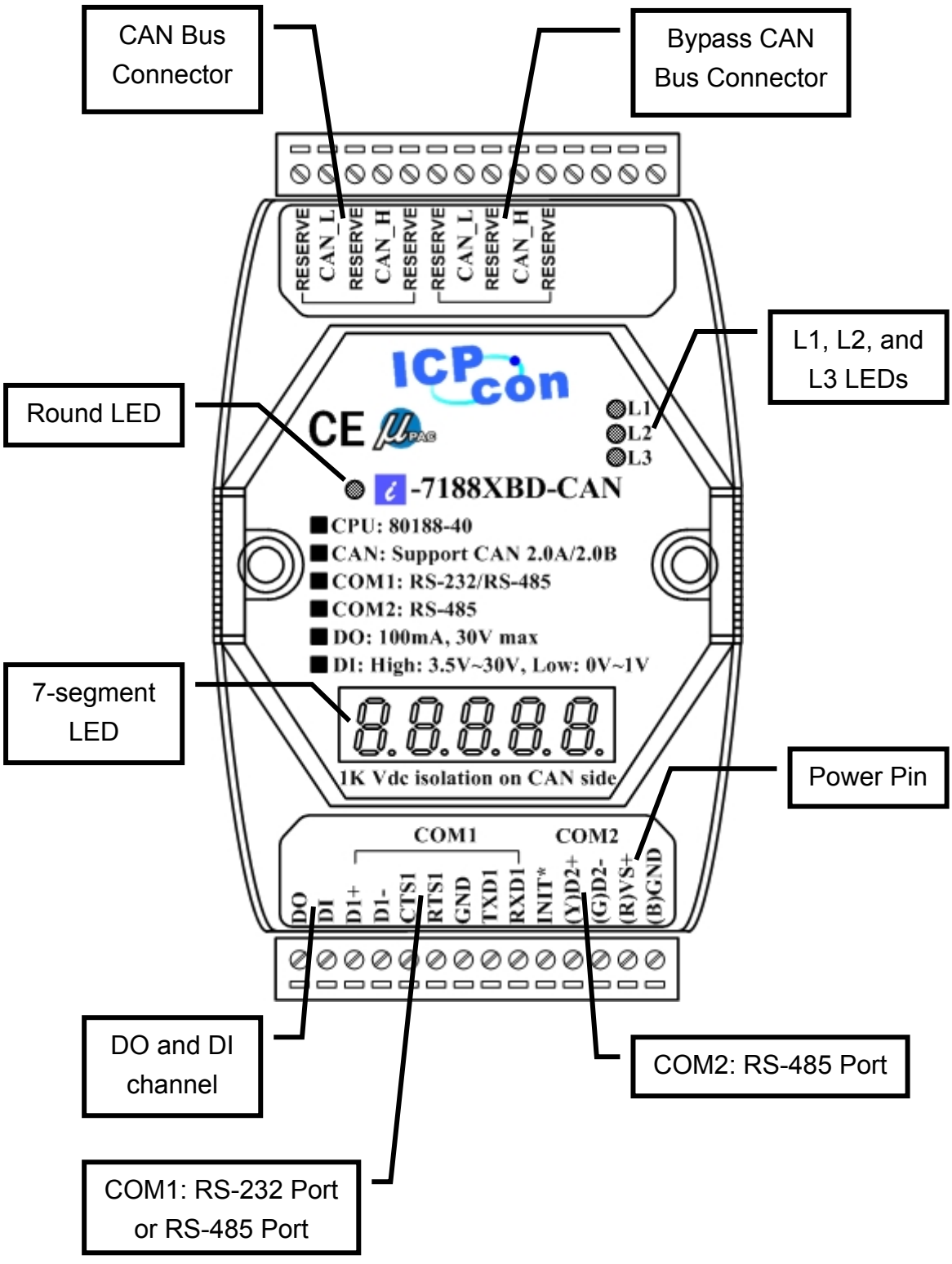
- 10 to 30 VDC (non-regulated)
- Power Supply: 3.0W

Application Environment

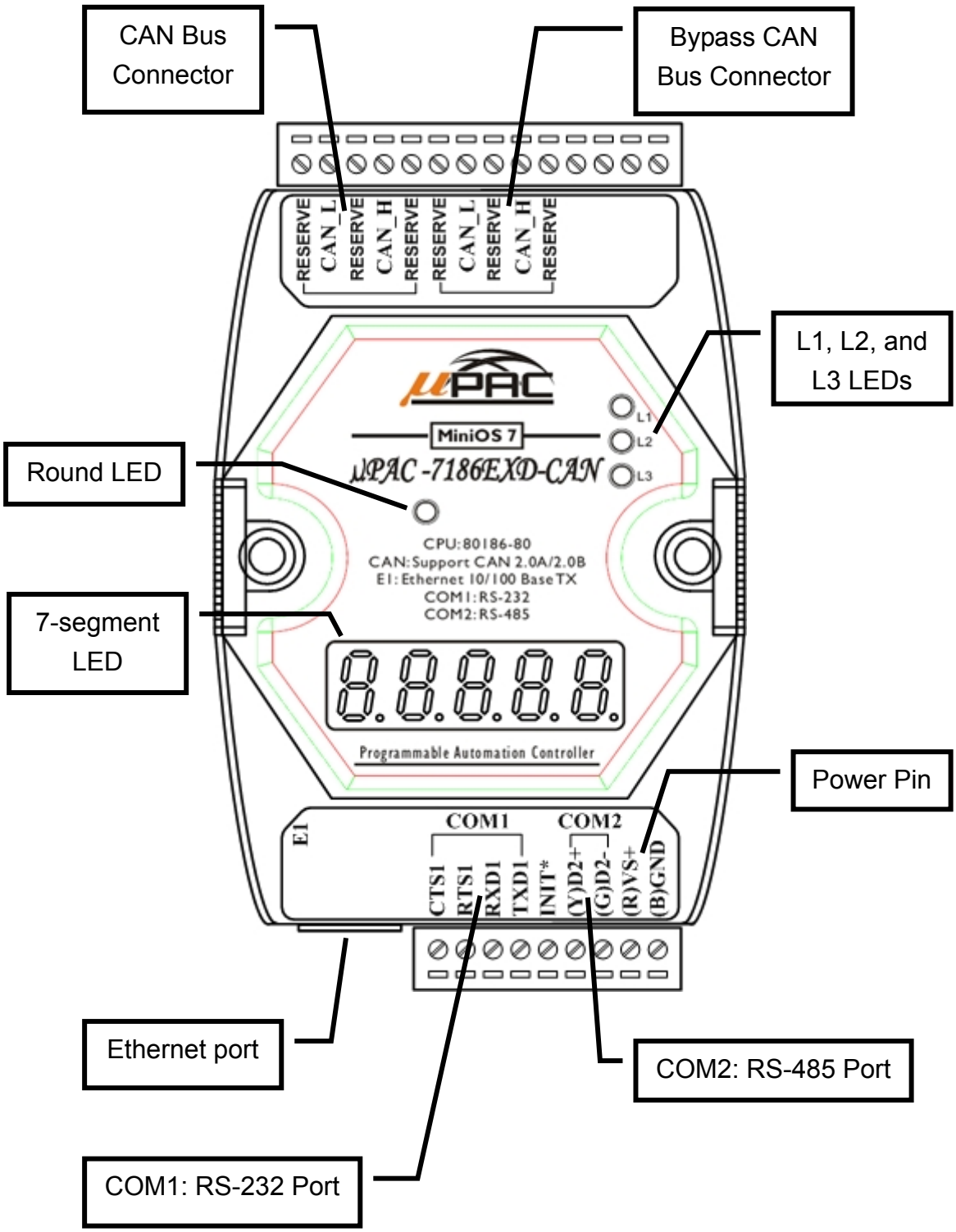
- Operating Temperature: -25°C to +75°C
  Storage Temperature: -30°C to +85°C
- Humidity: 5%~9
- Dimensions: 123mm*64.5mm*19.6mm

2 Hardware Configuration

2.1 I-7188XBD-CAN Hardware Structure

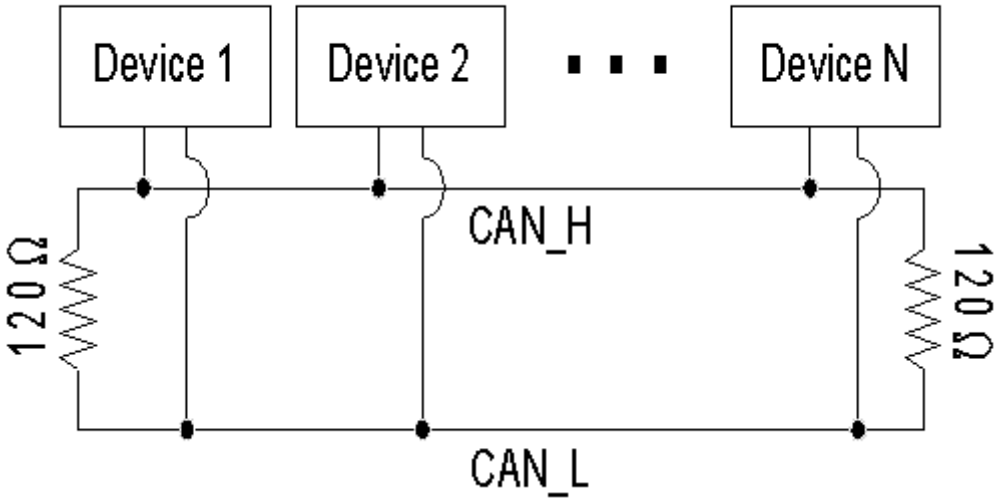


2.2 µPAC-7186EXD-CAN Hardware Structure



2.3 CAN Network Wire Connection

In order to minimize the reflection effects on the CAN bus line, the CAN bus line has to be terminated at both ends by two terminal resistances as following figure. According to the ISO 11898-2 spec, each terminal resistance is 120Ω (or between 108Ω~132Ω). The length related resistance should have 70 mΩ/m. The user should check the resistances of CAN bus, before install a new CAN network.



Moreover, in order to minimize the voltage drop on long distance, the terminal resistance should be higher than the value defined in the ISO 11898-2. The following table could be a reference.

Bus Length (meter)	Bus Cable Parameters		Terminal Resistance (Ω)
	Length Related Resistance (mΩ/m)	Cross Section (Type)	
0~40	70	0.25(23AWG)~ 0.34mm^2(22AWG)	124 (0.1%)
40~300	< 60	0.34(22AWG)~ 0.6mm^2(20AWG)	127 (0.1%)
300~600	< 40	0.5~0.6mm^2 (20AWG)	150~300
600~1K	< 20	0.75~0.mm^2 (18AWG)	150~300

The CAN bus bard rate has the high relationship with the bus length. The following table indicates the corresponding bus length on every kind of baud rate.

Baud rate (bit/s)	Max. Bus length (m)
1 M	25
800 K	50
500 K	100
250 K	250
125 K	500
50 K	1000
20 K	2500
10 K	5000

Note: When the bus length is greater than 1000m, the bridge or repeater devices may be needed.

2.4 Terminal Resistor Jumper Selection

Remove the cover of the I-7188XBD-CAN/µPAC-7186EXD-CAN. users can see the part of internal structure shown as following figure. The XC100 provides users one jumper-selected termination resistor (J3). Its position is displayed below.

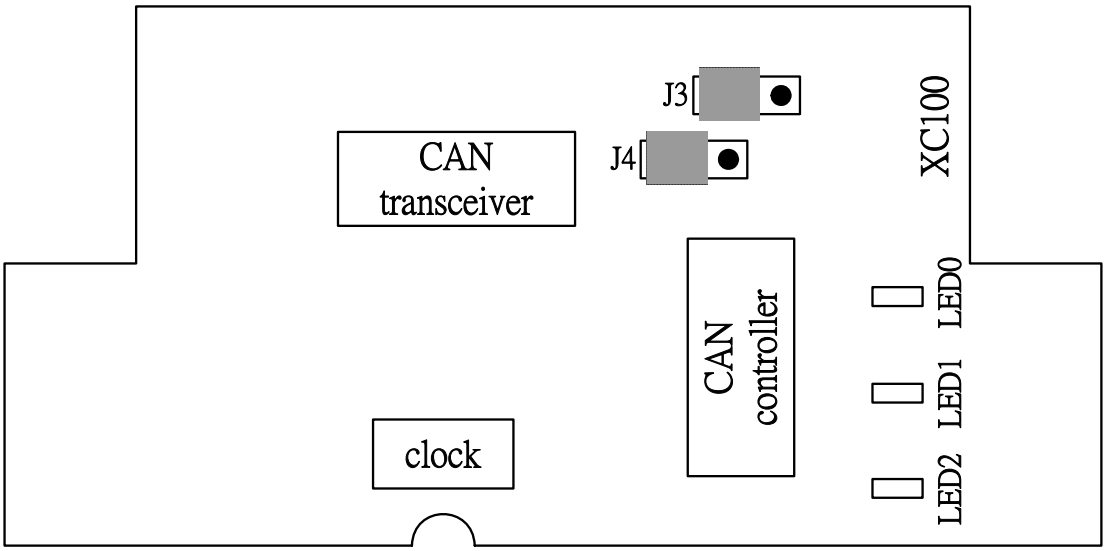


Figure2.1 XC100 I/O expansion board LAYOUT

The jumper J3 is used to judge the resister of CAN network. When users want to set the jumper JP3, the upper cover of I-7188XBD-CAN/ µPAC-7186EXD-CAN needs to be removed. About the J3 jumper setting, please refer the following figure.

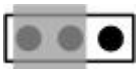
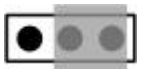
Apply the termination resistor(120Ω)	**Don't apply the termination resistor**
	

Table 2.1 J3 Jumper Selections

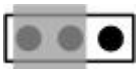
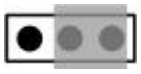
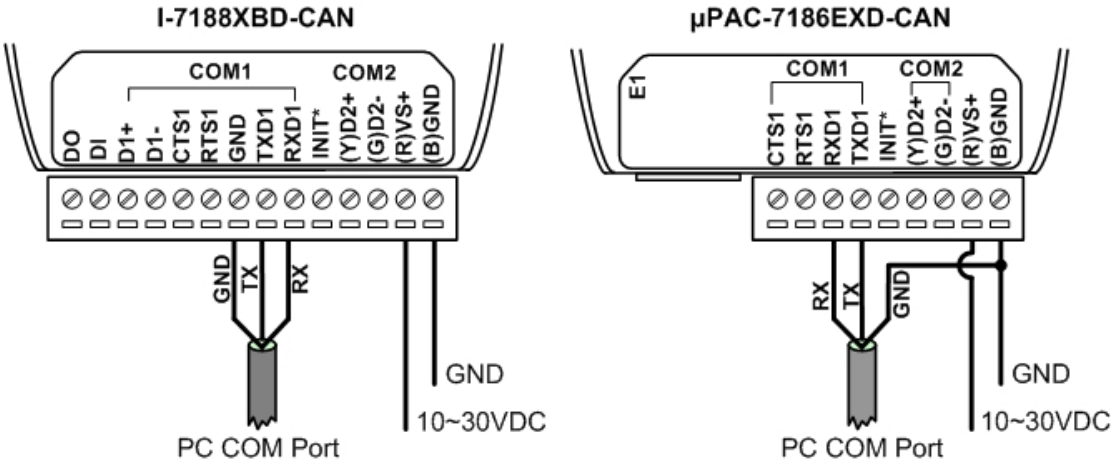
For(I-7188XBD-CAN)	**For(µPAC-7186EXD-CAN)**
	

Table 2.2 J4 Jumper Selections

2.5 Wiring Diagram For Different Application

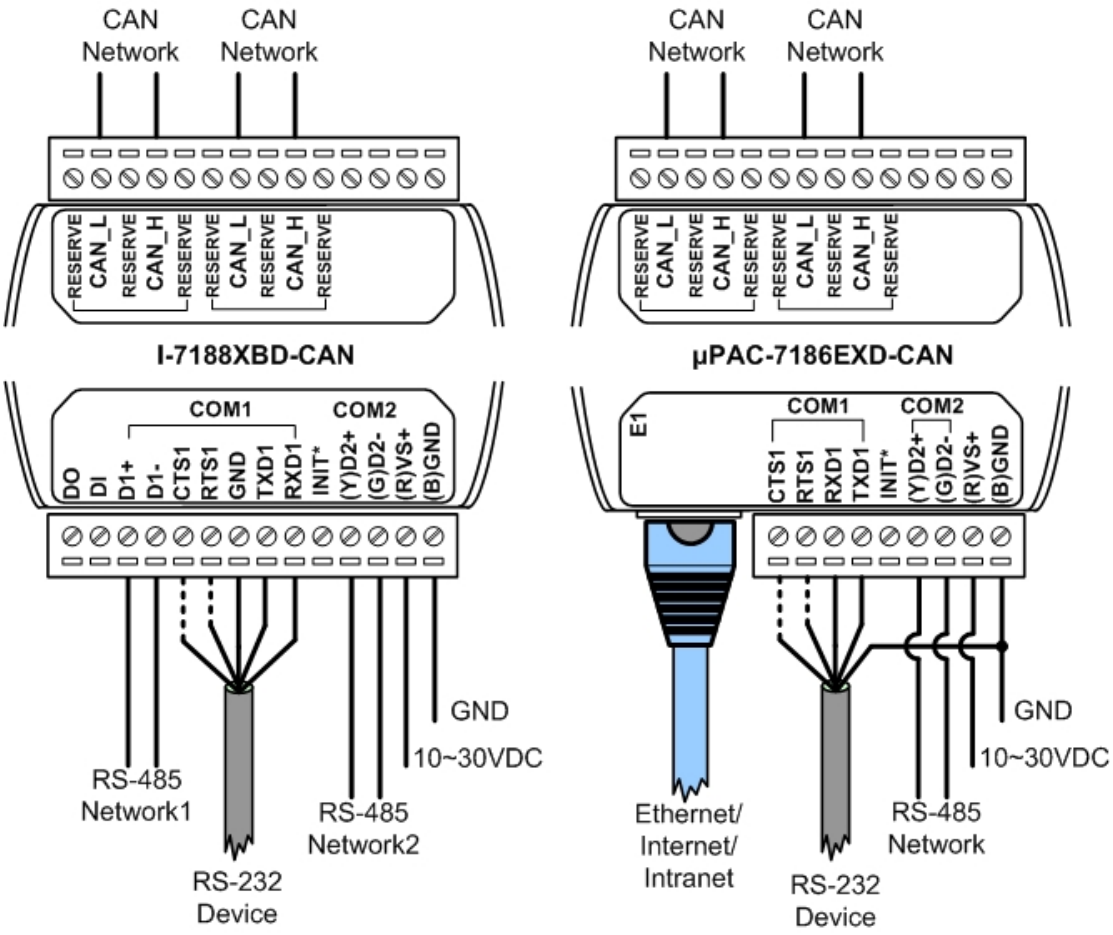
2.5.1 Program download

If users want to download users' program, the following structure may be needed. Users must use the download cable (packaged with I-7188XBD-CAN/ µPAC-7186EXD-CAN) to connect the I-7188XBD-CAN/ µPAC-7186EXD-CAN COM1 with PC available COM port. Then, use the tool, 7188xw.exe, in uPAC-7186EXD-CAN-OS-Image folder to download users' program. Please refer section 4 for more detail information.

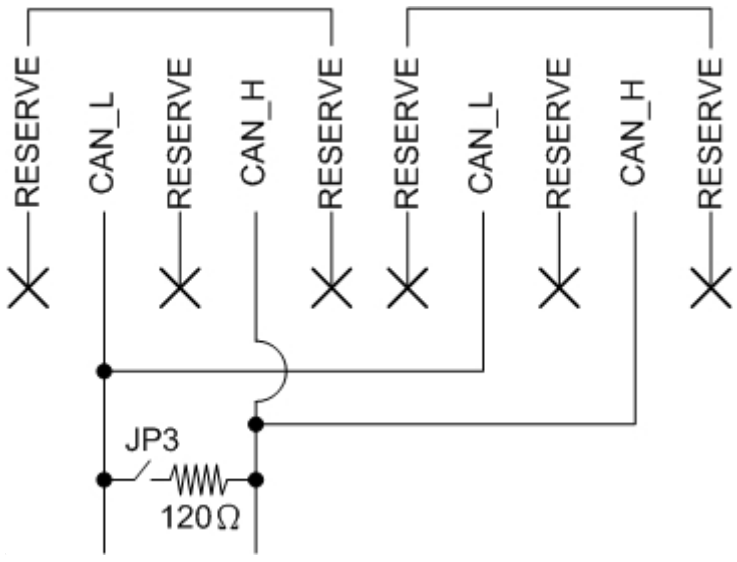


2.5.2 General application

The following figure shows the wiring diagram for general application. When the COM1 of I-7188XBD-CAN is used, sending data to COM1 will transmit the data both on RS-232 and RS-485 port. One of the RS-232 and RS-485 port receives the data, these data will be obtained by COM1 of the I-7188XBD-CAN. Therefore, it is not recommend using both RS-232 and RS-485 functions of COM1 at the same time. If users select the RS-232 function of COM1, the RTS1 and CTS1 pins are not always necessary. It is need to check if the connection target machine uses 3-line RS-232 communication or 5-line RS-232 communication.

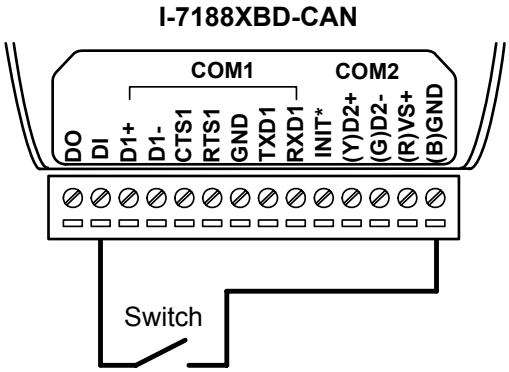


Moreover, in order to wire conveniently, the I-7188XBD-CAN/ μPAC-7186EXD-CAN provides not only one CAN port, but also another bypass CAN port. There two CAN ports are the same one. The bypass CAN port is just for wiring with another CAN device conveniently, it doesn't have any other function.

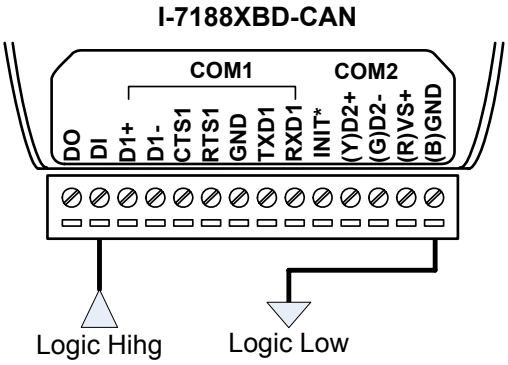


2.5.3 I-7188XBD-CAN DI & DO channel wiring diagram

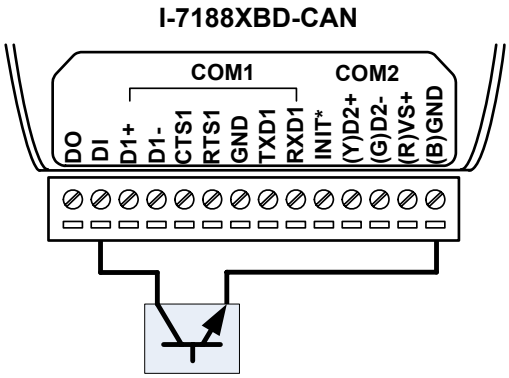
The general wire connection methods for DI channel of I-7188XBD-CAN are shown below.



Dry Contact Signal Input

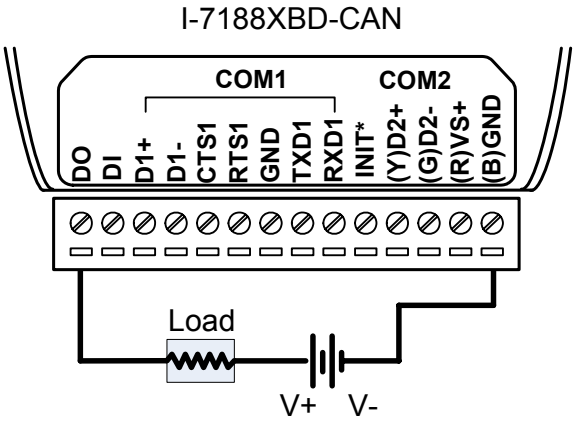


TTL/CMOS Signal Input



Open-Collector Signal Input

The DO channel of I-7188XBD-CAN wire connection is shown below.



3 XC100 Library

The XC100 library file, XC100L.lib, is useful to help user design various CAN devices. Here, the library for TC, BC and MSC is provided to receive CAN messages, transmit CAN messages, and configure the CAN controller. This section will show you what they have and how to use them. For developing a program, the figure 3.1 and 3.2 may be a reference. The XC100L.lib is only used for the XC100 hardware, and is for Large Mode of the C/C++ compiler. For the step-by-step information about the program procedure, please refer to the section 4.1.

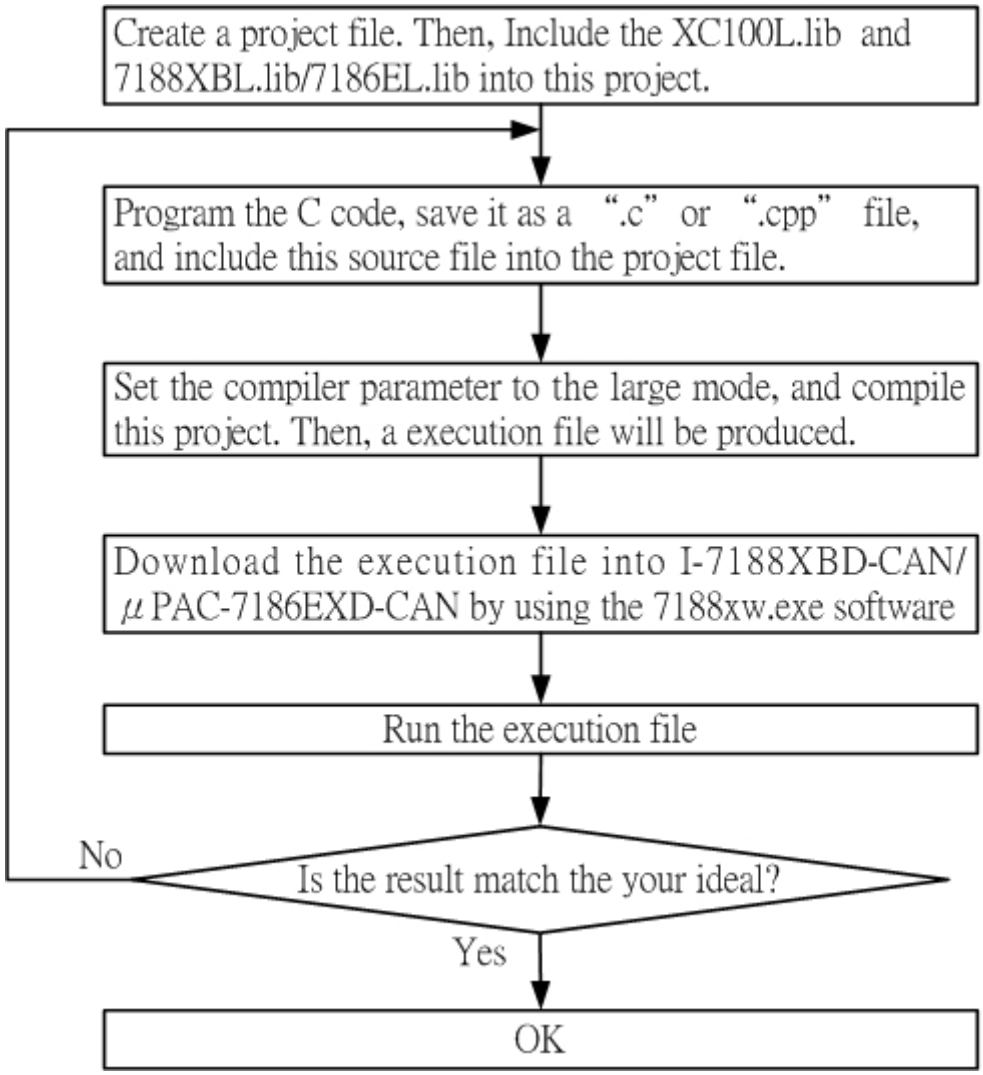

Create a project file. Then, Include the XC100L.lib and 7188XBL.lib/7186EL.lib into this project.
Program the C code, save it as a ".c" or ".cpp" file, and include this source file into the project file.
Set the compiler parameter to the large mode, and compile this project. Then, a execution file will be produced.
Download the execution file into I-7188XBD-CAN/ μPAC-7186EXD-CAN by using the 7188xw.exe software
Run the execution file
No
Is the result match the your ideal?
Yes
OK

Figure3.1 Program procedure

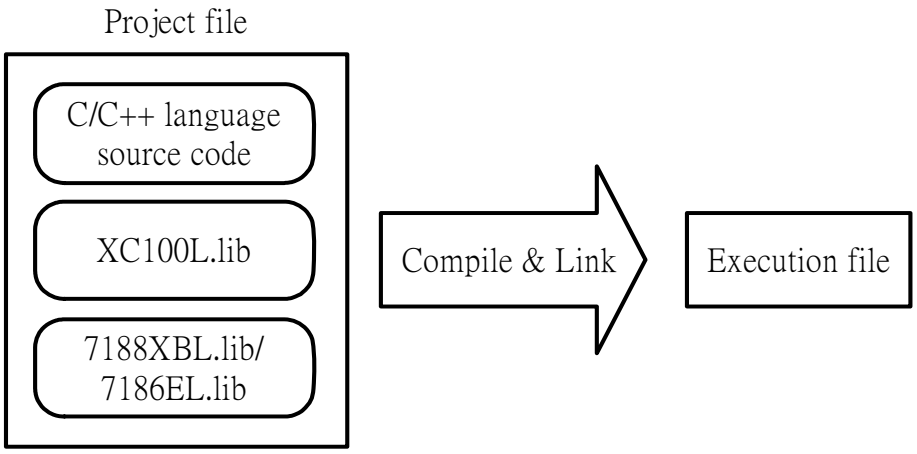


Figure3.2 Compile concept

Because this manual is special described for the CAN functions, if users want to know the other functions and demos of the I-7188XBD-CAN/µPAC-7186EXD-CAN (such as the EEPROM function, 7-segment function, flash ram function, real-time clock function, watchdog function, com port function, and so forth), please refer to the I-7188XB(D)/I-7188EX(D) user manual. Or refer to the on-line help on the 7000/7188/8000 CD. In this on-line help, users can find a lot of useful information about MiniOS7 operation commands, the other functions of I-7188XBD-CAN/ µPAC-7186EXD-CAN, and the functions of download tool, 7188xw.exe. MiniOS7 is the operation system of the I-7188XBD-CAN/ µPAC-7186EXD-CAN. It is a dos-like operation system. The 7188xw.exe is a download tool. If users want to download users' program into the I-7188XBD-CAN/ µPAC-7186EXD-CAN, this tool may be needed. Users can find the 7188xw.exe in the uPAC-7186EXD-CAN-OS-Image folder in CAN CD. It path is "CAN/PAC/uPAC-7186EXD-CAN". (**Note: I-7188EX(D) demos can be used in the µPAC-7186EXD-CAN. Users just need to compile I-7188EX(D) demos again with 7186EL.lib. Both I-7188XBD-CAN and µPAC-7186EXD-CAN functions can refer to the following on-line help.**)

For on-line help:
Napdos \MiniOS7\doc\eng\index.htm (For English)
Napdos \MiniOS7\doc\gb2312\index.htm (For Simple Chinese)
Napdos \MiniOS7\doc\big5\index.htm (For Transitional Chinese)

For demos:
Napdos\7188x\minios7\7188xb\demo (For I-7188XBD-CAN)
Napdos\7188e\MiniOS7\demo (For uPAC-7186EXD-CAN)
Napdos\7188e\Tcp\Demo (For uPAC-7186EXD-CAN)
Napdos\7188e\Udp\Other (For uPAC-7186EXD-CAN)

3.1 Library Function Definition and Description

The functions of XC100 library file are presented in the following table. They are provided to help users construct their characteristic CAN device. For the detail information of each function, please refer to the following sub-section.

Function definition	Description	Page
CAN_Reset	CAN controller hardware reset	20
XC100Init	Initialize the XC100 hardware	21
SetCANBaud	Change CAN baud	26
SetCANMask	Change CAN message filter	27
CAN_InstallIrq	Enable the embedded controller interrupt	28
CAN_RemoveIrq	Disable the embedded controller interrupt	29
CAN_Restore	Release the resource and disable the embed controller interrupt	30
CAN_CreateBuffer	Change the reception and transmission buffer sizes	31
SendCANMsg	Send a CAN message to the CAN network	32
GetCANMsg	Receive a CAN message	34
GetStatus	Obtain the CAN controller status and reception/transmission buffer status	36
ClearStatus	Reset the reception and transmission buffer status	37
L1Off	Turn LED0 off	38
L2Off	Turn LED1 off	39
L3Off	Turn LED2 off	40
L1On	Turn LED0 on	41
L2On	Turn LED1 on	42
L3On	Turn LED2 on	43
UserCANInt	Design user-defined interrupt routine	44

Table3.1 The function list of the XC100 library file

3.1.1 CAN_Reset

- **Description:**

  Reset the CAN controller by hardware circuit. After running this function, the CAN controller will be set to initial state. For more information about this, please refer to the SJA1000 data sheet on the web site.

  http://www.semiconductors.philips.com/pip/SJA1000.html#datasheet

  .

- **Syntax:**

  void CAN_Reset(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  None

3.1.2 XC100Init

- **Description:**

  Initialize the software buffer and XC100 hardware, which includes CAN controller, L1 LED, L2 LED and L3 LED.

- **Syntax:**

  int XC100Init(int TypeOf7188,char IntMode, unsigned long CANBaud,
  char BT0, char BT1,unsigned long AccCode,
  unsigned long AccMask)

- **Parameter:**

  TypeOf7188: define what kind of module you use.

value	TypeOf7188
0	For I-7188XBD-CAN
1	For µPAC-7186EXD-CAN

  IntMode: Set the CAN controller interrupt mode. Each bit of IntMode parameters indicates different function shown as follows.

Interrupt Type	Value of IntMode
Receive Interrupt Enable	0x01
Transmit Interrupt Enable	0x02
Error Warning Interrupt Enable	0x04
Data Overrun Interrupt Enable	0x08
Wake-up Interrupt Enable	0x10
Error Passive Interrupt Enable	0x20
Arbitration Lost Interrupt Enable	0x40
Bus Error Interrupt Enable	0x80

Interrupt Type	Meaning
Receive Interrupt	When a message has been received without errors, the receive interrupt will be triggered.
Transmit Interrupt	When a message has been successfully transmitted or the transmit buffer is accessible again, the transmit interrupt will be triggered.
Error Warning Interrupt	If the error or bus status is set or clear, the error interrupt will be triggered.
Data Overrun Interrupt	If a message was lost because there was not enough space for that message in the FIFO (FIFO has 64 bytes), the overrun interrupt will be triggered.
Wake-up Interrupt	When the CAN controller is sleeping and bus activity is detected. The Wake-up interrupt will be triggered.
Error Passive Interrupt	If CAN controller has at least one error counter exceeds the protocol-defined level of 127 or if the CAN controller is in the error passive status, the Error Passive Interrupt will be triggered.
Arbitration Lost Interrupt	When the CAN controller lost the arbitration and becomes a receiver. The Arbitration Lost Interrupt will be triggered.
Bus Error Interrupt	When the CAN controller detects an error on the CAN bus, the Bus Error Interrupt will be triggered.

Use one-byte value to implement the interrupt. For example, if Receive and overrun interrupt are needed in the BasicCAN(CAN 2.0A) mode. Set the IntMode value to 0x09(That is 0x01+0x08.).

CANBaud: Use a long int to set this parameter. For example, if users want to set CAN baud to 125K bps. Use the value 125000UL.

BT0, BT1: Set the special user-defined baud rate. Users can set arbitrary baud with these parameters. But users need to have the background of SJA1000 CAN controller and 82C251 CAN transceiver, and calculate the values of BT0 and BT1 by themselves (The clock frequency of CAN controller is 16MHz.).

AccCode, AccMask: The AccCode is used for deciding what kind of ID the CAN controller will accept. The AccMask is used for deciding which bit of ID will need to check with AccCode. If the bit of AccMask is set to 0, it means that the bit in the same position of ID need to be checked, and the bit value ID need to match the bit of AccCode in the same position.

For 11-bit ID Message:

Register	bits of register	Filter Target
AccCode[0] and AccMask[0]	bit7~bit0	bit10 ~ bit3 of ID
AccCode[1] and AccMask[1]	bit7~bit5	bit2 ~ bit0 of ID
AccCode[1] and AccMask[1]	bit4	RTR
AccCode[1] and AccMask[1]	bit3~bit0	no use
AccCode[2] and AccMask[2]	bit7~bit0	bit7 ~ bit0 of 1st byte data
AccCode[3] and AccMask[3]	bit7~bit0	bit7 ~ bit0 of 2nd byte data

For 29-bit ID Message:

Register	bits of register	Filter Target
AccCode[0] and AccMask[0]	bit7~bit0	bit28 ~ bit21 of ID
AccCode[1] and AccMask[1]	bit7~bit0	bit20 ~ bit13 of ID
AccCode[2] and AccMask[2]	bit7~bit0	bit12 ~ bit5 of ID
AccCode[3] and AccMask[3]	bit7~bit3	bit4 ~ bit0 of ID
AccCode[3] and AccMask[3]	bit2	RTR
AccCode[3] and AccMask[3]	bit1~bit0	no use

Note: 1. AccCode[0] means the most significant byte of AccCode and

AccCode[3] means the least significant byte of AccCode.

2. AccMask[0] means the most significant byte of AccMask and

AccMask[3] means the least significant byte of AccMask.

3. Bit10 is most significant bit and Bit0 is least significant bit

For example (In 29 bit ID message):

AccCode : 00h 00h 00h A0h

AccMask : FFh FFh FFh 1Fh

ID Value : ?? ?? ?? Ah and Bh will be accepted. (??: don't care)

(Note: The mark “h” behind the value means hex format.)

- **Return:**

  CAN_NoError: OK

  CAN_BaudNotSupport: Input baudrate is not support.

  CAN_ResetError: Reseting the CAN controller is fail.

  CAN_ConfigError: Confuguring the CAN controller register is fail.

  CAN_SetACRError: Setting the AccCode register is fail

  CAN_SetAMRError: Setting the AccCode register is fail

  CAN_NotEnoughMemory: Create a reception/transmission software buffer for CAN messages are fail.

  CAN_TypeOf7188Error: The type of the 7188 is not defined of this library.

- **Relative function:**

  None

3.1.3 SetCANBaud

- **Description:**

  This function is used to change the CAN baud after calling XC100init function.

- **Syntax:**

  int SetCANBaud(unsigned long CANBaud, char BT0, char BT1)

- **Parameter:**

  CANBaud, BT0, BT1: Please refer to the parameters description in the XC100Init function in section 3.1.2.

- **Return:**

  CAN_NoError: OK

  CAN_BaudNotSupport: This baud rate is not supported.

  CAN_ResetError: CAN controller can't enter the reset mode. So, all parameters can't be set normally.

- **Relative function:**

  3.1.2 XC100Init

3.1.4 SetCANMask

- **Description:**

  This function is used to change the CAN message filter after using XC100init function.

- **Syntax:**

  int SetCANMask(unsigned long AccCode, unsigned long AccMask)

- **Parameter:**

  AccCode, AccMask: Please refer to the parameters description in the XC100Init function in section 3.1.2.

- **Return:**

  CAN_NoError: OK

  CAN_ResetError: Reseting the CAN controller is fail.

  CAN_SetACRError: Setting the AccCode register is fail

  CAN_SetAMRError: Setting the AccCode register is fail

- **Relative function:**

  3.1.2 XC100Init

3.1.5 CAN_InstallIrq

- **Description:**

  Set the interrupt function enable. Afterwards, the CPU of I-7188 series embedded controller can receive the interrupt signal from CAN controller.

- **Syntax:**

  void CAN_InstallIrq(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.6 CAN_RemoveIrq

3.1.6 CAN_RemoveIrq

- **Description:**

  Disable the interrupt function. Afterwards, the CPU of I-7188 series embedded controller can't receive the interrupt signal from CAN controller.

- **Syntax:**

  void CAN_RemoveIrq(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.5 CAN_InstallIrq

3.1.7 CAN_Resotre

- **Description:**

  Set the interrupt function disable, release all software buffer, and reset CAN chip. This function must be called to release resource before the program is terminated.

- **Syntax:**

  void CAN_Restore(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  None

3.1.8 CAN_CreateBuffer

- **Description:**

  Call this function for changing the reception and transmission software buffer sizes. If users don't use this function, the default reception and transmission software buffer sizes are both 256 records.

- **Syntax:**

  int CAN_CreateBuffer(int BufMode, unsigned int BufferSize)

- **Parameter:**

  BufMode: 0 for changing reception software buffer size.

  Others for changing transmission software buffer.

  BufferSize: the new buffer sizes for software buffer.

- **Return:**

  CAN_NoError: OK

  CAN_NotEnoughMemory: Create a reception/transmission software buffer for CAN messages are fail.

- **Relative function:**

  3.1.2 XC100Init

3.1.9 SendCANMsg

- **Description:**

  If the transmit buffer is disable, this function will send a message to the CAN network. However, if the transmit buffer is enable, this function will send all the messages stored in the transmit buffer to the CAN network.

- **Syntax:**

  int SendCANMsg(unsigned char Mode,unsigned long MsgID, unsigned char RTR, unsigned char DataLen,
  unsigned char *Data)

- **Parameter:**

  Mode: This parameter is used for CAN ID type.

Mode value	Meaning
0	Send a 11-bit ID CAN message
others	Send a 29-bit ID CAN message

  MsgID: The ID of this CAN message. The ID may be a 11-bit value or 29-bit value.

  RTR: Remote transmits request byte.

RTR value	Meaning
0	This CAN message is not a remote transmit request message.
1	This CAN message is a remote transmit request message.

  DataLen: The pure data length of a CAN messages. The range of this value is 0~8.

  *Data: Store the data of CAN message. The numbers of data bytes need to match with the "DataLen".

- **Return:**

  CAN_NoError: OK

  CAN_DataLengthError: CAN message data length is over 8.

  CAN_TransmitBufferLocked: CAN controller transmit buffer is locked.

  CAN_TransmitIncomplete: CAN controller can't send the message successfully.

- **Relative function:**

  3.1.2 XC100Init

3.1.10 GetCANMsg

- **Description:**

  Receive CAN messages from receive buffer or from CAN bus directly. If the receive interrupt is set to enable in IntMode parameter of XC100Init function. This function will read back the CAN message stored in the software receive buffer. If the receive interrupt is disable, this function uses the polling method to check if there is any CAN message in CAN chip buffer. If yes, return the CAN message.

- **Syntax:**

  int GetCANMsg(unsigned char *Mode, unsigned long *MsgID
  , unsigned char *RTR, unsigned char *DataLen
  , unsigned char *Data, unsigned long *UpperTime
  , unsigned long *LowerTime)

- **Parameter:**

  *Mode: This parameter is used for get the ID type (11-bit or 29-bit ID) of a CAN message.

  *MsgID: This is for obtaining the ID of a CAN message.

  *RTR: This is for obtaining the RTR of a CAN message.

RTR value	Meaning
0	This CAN message is not a remote transmit request message.
1	This CAN message is a remote transmit request message.

  *DataLen: This is for obtaining the data length of a CAN message.

*Data: This is for obtaining the Data of a CAN message. The Data buffer size must be 8 bytes.

*UpperTime: Get the time stamp of a CAN message. The time stamp unit is us (micro second), This parameter only show the upper part of time stamp.

Real time stamp = upper part * 0x100000000UL+lower part

*LowerTime: Get the lower part of time stamp of a CAN message.

- **Return:**

CAN_NoError: OK

CAN_ReceiveBufferEmpty: No message is in the CAN receive buffer.

CAN_SoftBufferIsEmpty: No message is in the software receive buffer.

CAN_DataLengthError: The Data length of received message is over than 8.

- **Relative function:**

3.1.2 XC100Init

3.1.11 GetStatus

- **Description:**

  Read the CAN controller status and software buffer overflow flag message.

- **Syntax:**

  void GetStatus(unsigned char *CANReg, unsigned char *OverflowFlag)

- **Parameter:**

  * CANReg: The pointer for obtain the current CAN controller status. For the information about the CANReg value meaning, please refer to the following table.

Bit NO.	Description
7 (MSB)	Bus status. 1 for bus off, 0 for bus on.
6	Error status. 1 for at least one error, 0 for OK.
5	Transmit status. 1 for transmitting, 0 for idle.
4	Receive status. 1 for receiving, 0 for idle.
3	Transmit complete status. 1 for complete, 0 for incomplete.
2	Transmit buffer status. 1 for released, 0 for locked
1	Data overrun status. 1 for reception buffer overrun, 0 for OK.
0 (LSB)	Receive buffer status. 1 for at least one message stored in the reception buffer, 0 for empty.

  * OverflowFlag: CAN reception and transmission overflow flag information For the information about the OverflowFlag value meaning, please refer to the following table.

Bit NO.	Description
Others	Reserved
1	1 for reception software buffer overflow. 0 for normal.
0 (LSB)	1 for transmission software buffer overflow. 0 for normal.

- **Return:**

  None

- **Relative function:**

  3.1.12 ClearStatus

3.1.12 ClearStatus

- **Description:**

  This function is used for cleaning the CAN reception or transmission software buffer overflow flag. When one of these two buffers is full, the corresponding overflow flag will be set to 1. In this case, users need to use this function to clear the overflow flag to acknowledge the error information.

- **Syntax:**

  void ClearStatus(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.11 GetStatus

3.1.13 L1Off

- **Description:**

  Turn the L1 LED off. About the position of L1 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L1Off(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.16 L1On

3.1.14 L2Off

- **Description:**

  Turn the L2 LED off. About the position of L2 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L2Off(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.17 L2On

3.1.15 L3Off

- **Description:**

  Turn the L3 LED off. About the position of L3 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L3Off(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.18 L3On

3.1.16 L1On

- **Description:**

  Turn the L1 LED on. About the position of L1 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L1On(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.13 L1Off

3.1.17 L2On

- **Description:**

  Turn the L2 LED on. About the position of L2 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L2On(void)

- **Parameter:**

  None

- **Return:**

  None

- **Relative function:**

  3.1.14 L2Off

3.1.18 L3On

- **Description:**

  Turn the L3 LED on. About the position of L3 LED, please refer to the figure 2.1 in the section 2.1.

- **Syntax:**

  void L3On(void)

- **Parameter:**

  None

- **Return:**

  None

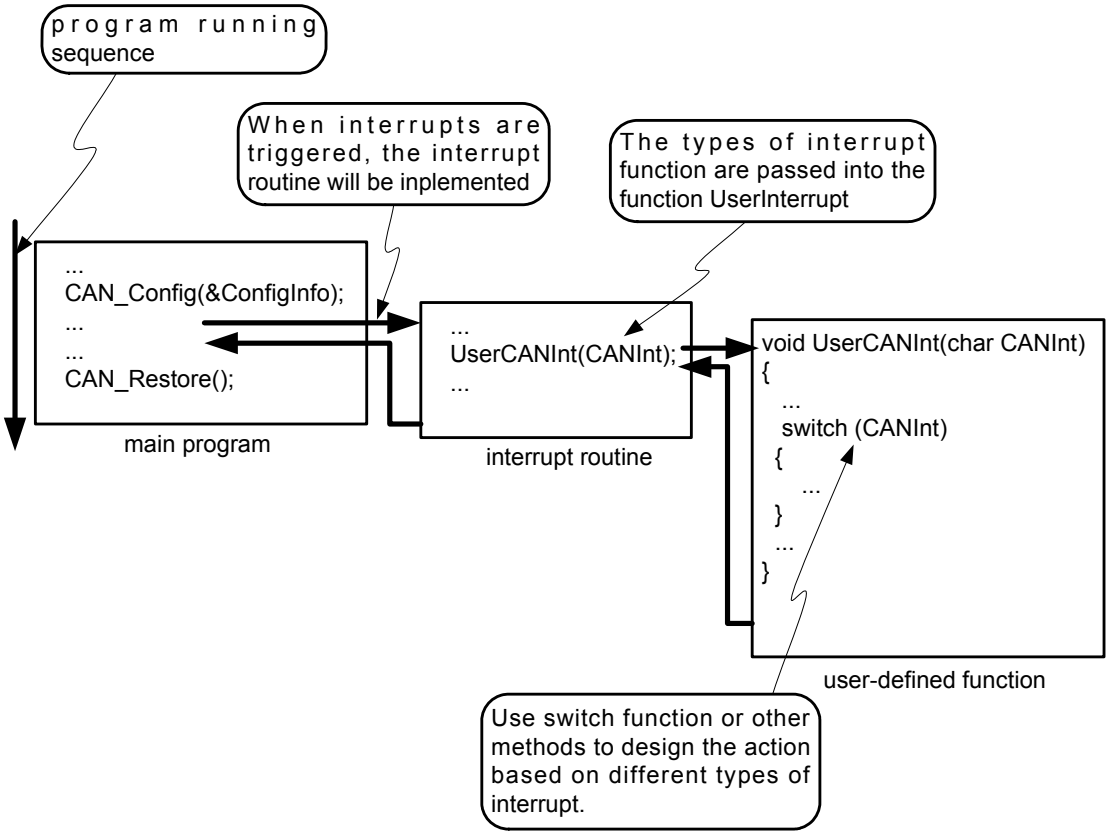
- **Relative function:**

  3.1.15 L3Off

3.1.19 UserCANInt

- **Description:**

  This function is created by users and is used to program the CAN interrupt service routine by users. The parameter CANINT is passed automatically when the interrupt functions are triggered. It indicates what kinds of CAN controller interrupt are active. Therefore, users only need to design their interrupt routine according to dealing with different interrupt functions. If it is not used, please reverse this function in the users' .C file for avoiding the complier error. The following figure is the general concept of the function UserCANInt.



- **Syntax:**

  void UserCANInt(char CANInt)

- **Parameter:**

  CANInt: The interrupt service routine will bypass the CANInt parameter to users to indicate what interrupt is triggered. For the meanings of CANInt parameters, please refer to the following table.

CANIntMode Value (Hex)	Meaning
0x01	Receive a message successfully
0x02	Transmit a message successfully
0x04	Error warring
0x08	Data Overrun
0x10	CAN controller wake-up
0x20	Bus Passive
0x40	Arbitration Lost
0x80	Bus Error

- **Return:**

  None

- **Relative function:**

  3.1.2 XC100Init

3.2 Table of Return Code

Return Code	Error ID	Comment
0	CAN_NoError	OK
5	CAN_ResetError	Enter reset mode error
8	CAN_ConfigError	CAN chip configure error
9	CAN_SetACRError	Set to Acceptance Code Register error
10	CAN_SetAMRError	Set to Acceptance Mask Register error
11	CAN_SetBaudRateError	Set Baud Rate error
14	CAN_InstallIrqFailure	Enable interrupt functions failure
15	CAN_RemoveIrqFailure	Disable interrupt functions failure
16	CAN_TransmitIncomplete	Data can't be transmitted successfully
17	CAN_TransmitBufferLocked	Previously transmission is not completed yet
18	CAN_ReceiveBufferEmpty	No message is stored in the receive buffer now
19	CAN_DataOverrun	Data was lost because there was not enough space in software receive buffer
20	CAN_ReceiveError	Receive data is not completed
21	CAN_SoftBufferIsFull	Software transmit buffer is full
22	CAN_SoftBufferIsEmpty	There is no message stored in the user-declared software buffer
23	CAN_BaudNotSupport	This Baud Rate is not supported
24	CAN_DataLengthError	Data length doesn't match the total data bytes
25	CAN_NotEnoughMemory	There is not enough memory space to create the reception or transmission software buffer.
26	CAN_TypeOf7188Error	The type of 7188 is not defined by this library

4 Demo Programs

The following architecture is shown in the I-7188XBD-CAN folder.

|--\manual → Users manual
|--\I-7188XBD-CAN OS image → OS image used for testing demo
|--\ LIB100 → BC++3.1 library folder
|--\BCPP31 → BC++3.1 demo folder
  |--\AC_AM → BC++3.1 AC_AM demo folder
  |--\All_Demo → BC++3.1 All_Demo demo folder
  |--\L1_L2_L3 → BC++3.1 L1_L2_L3 demo folder
  |--\RxInt → BC++3.1 RxInt demo folder
  |--\RxPoll → BC++3.1 RxPoll demo folder
  |--\TxInt → BC++3.1 TxInt demo folder
  |--\TxPoll → BC++3.1 TxPoll demo folder
  |--\UserInt → BC++3.1 UserInt demo folder
|--\TCPP31 → TC++1.01 demo folder
  |--\AC_AM → TC++1.01 AC_AM demo folder
  |--\All_Demo → TC++1.01 All_Demo demo folder
  |--\L1_L2_L3 → TC++1.01 L1_L2_L3 demo folder
  |--\RxInt → TC++1.01 RxInt demo folder
  |--\RxPoll → TC++1.01 RxPoll demo folder
  |--\TxInt → TC++1.01 TxInt demo folder
  |--\TxPoll → TC++1.01 TxPoll demo folder
  |--\UserInt → TC++1.01 UserInt demo folder
|--\MSC → MSC 1.52 demo folder
  |--\AC_AM → MSC 1.52 AC_AM demo folder
  |--\All_Demo → MSC 1.52 All_Demo demo folder
  |--\L1_L2_L3 → MSC 1.52 L1_L2_L3 demo folder
  |--\RxInt → MSC 1.52 RxInt demo folder
  |--\RxPoll → MSC 1.52 RxPoll demo folder
  |--\TxInt → MSC 1.52 TxInt demo folder
  |--\TxPoll → MSC 1.52 TxPoll demo folder
  |--\UserInt → MSC 1.52 UserInt demo folder

Here, the demo programs of XC100 library file with BC++3.1, TC++1.01 and MSC 1.52 are provided. The content of each demo is displayed in the following table. When users want to compile the demo program, please move the demo folder into a new folder named with max 8 letters. The BC++3.1/TC++1.01/MSC6 compilers are 16-bit compilers and may have a trouble because of the long file name. The µPAC-7186EXD-CAN folder architecture is similar as the I-7188XBD-CAN folder architecture. Therefore, if users use µPAC-7186EXD-CAN the similar architecture described above will be seen.

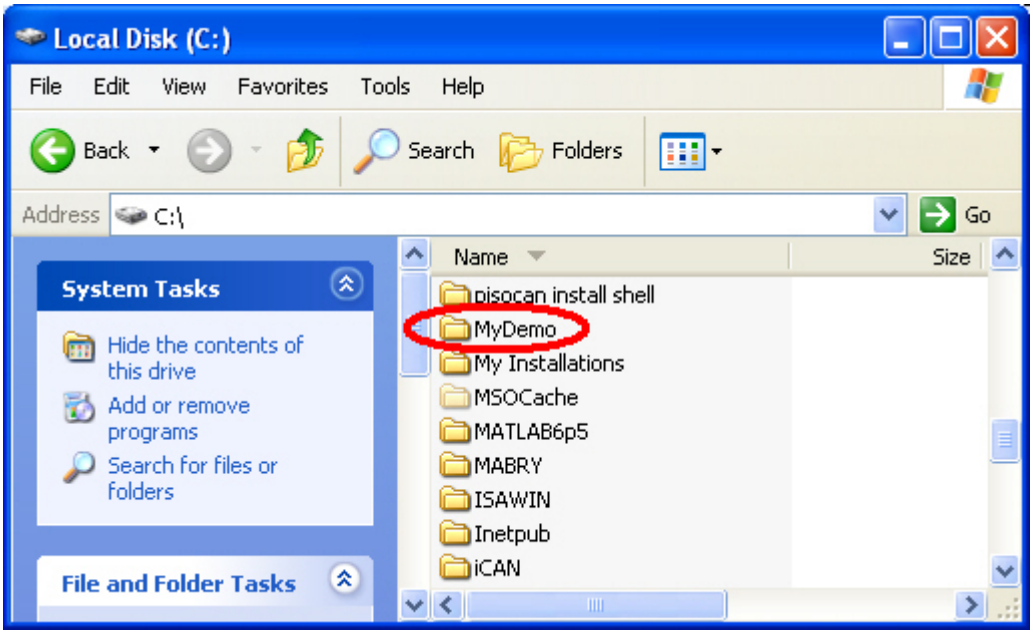
Demo	Content
AC_AM	Use the AccCode and AccMask
All_Demo	Demo the total functions provided by the XC100L.lib.
L1_L2_L3	Use the L1, L2, and L3 LEDs.
RxInt	Receive the CAN messages by interrupt mode
RxPoll	Receive the CAN messages by polling mode
TxInt	Send the CAN messages to the CAN network by interrupt mode.
TxPoll	Send the CAN messages to the CAN network by polling mode.
UserInt	Use the UserCANInt function to apply the users' CAN interrupt service routine.

In order to introduce users to use the XC100 library file clearly, there is a step-by-step procedure in the following section. It can give a good model to show how to build an execution file with XC100L.lib, download the users' program, and run it on the I-7188XBD-CAN/µPAC-7186EXD-CAN.

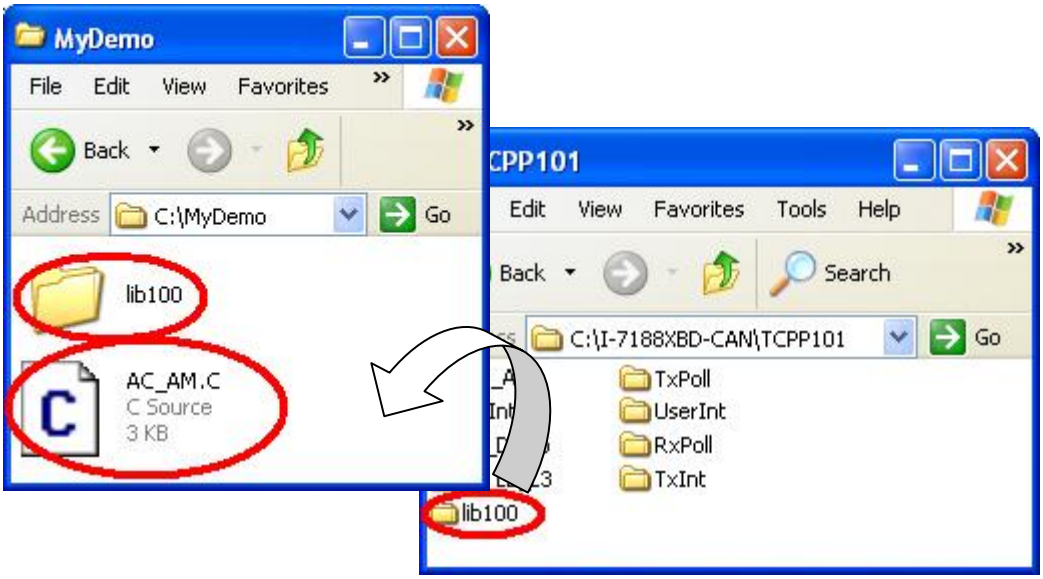
4.1 Program Download Procedure

Here, it is considered that how to build an execution file with XC100L.lib and how to run this program on the I-7188XBD-CAN/µPAC-7186EXD-CAN.

Step1: Create a folder named “MyDemo” in the C disk.

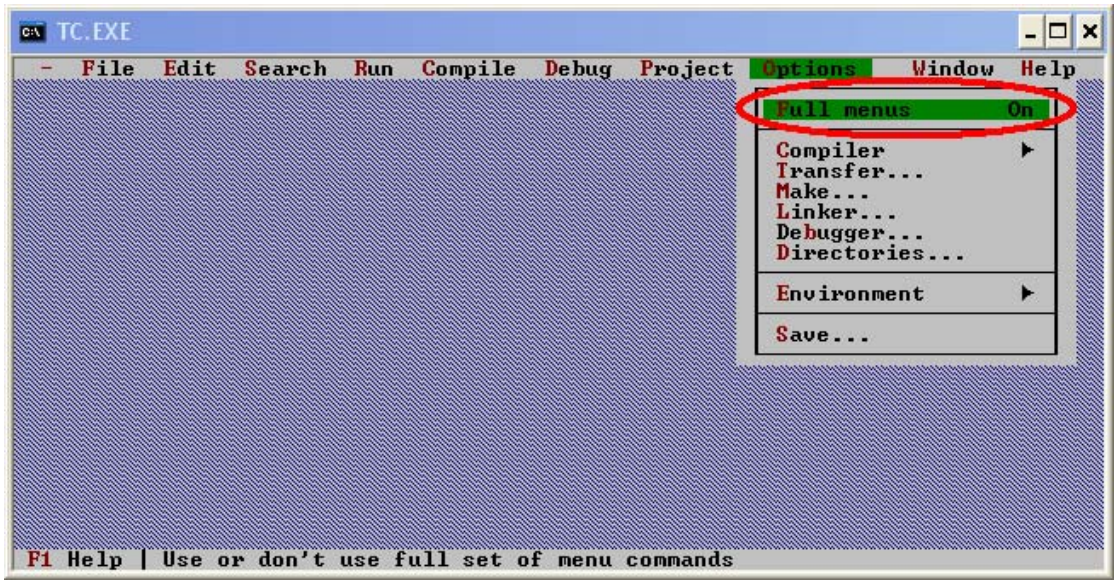


Step2: Copy the lib folder from the TCPP101\lib100 folder, which has the library files, XC100L.lib and I-7188XBL.lib. Then, modify the name of “lib100” folder to the “lib” Copy users program in to the MyDemo folder, too.

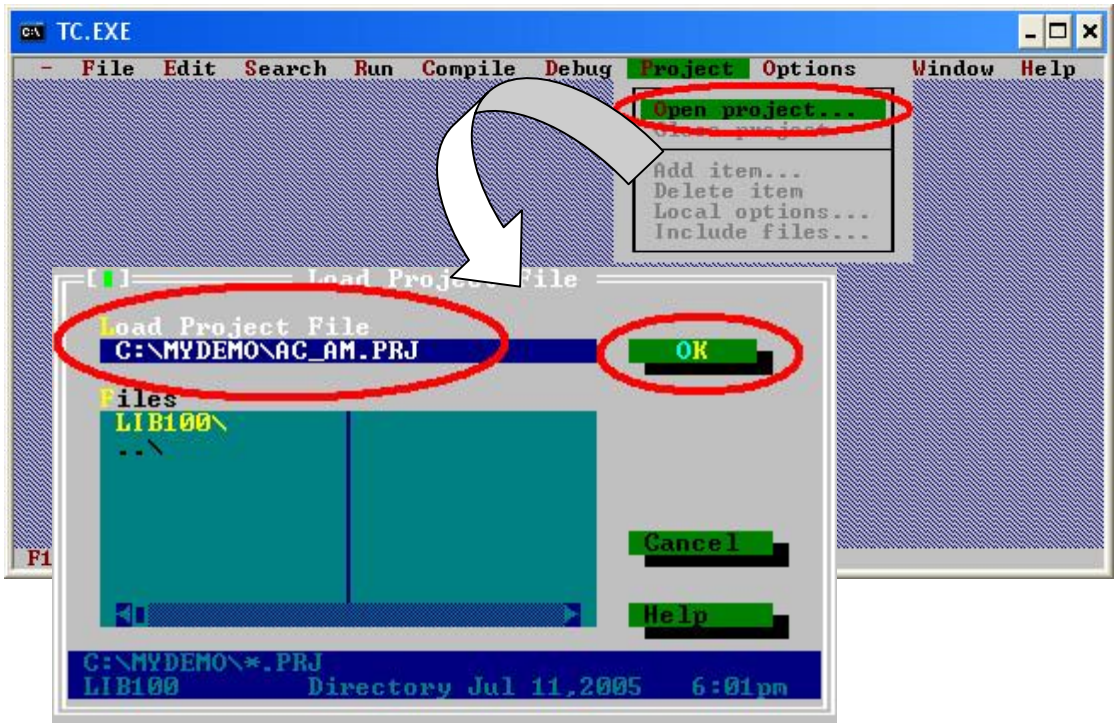


Step3: Run the TC++1.01 development environment. Click the “Options\Full menus” to expand the all functions of menus. Users can free download the TC++1.01 from the following web site.

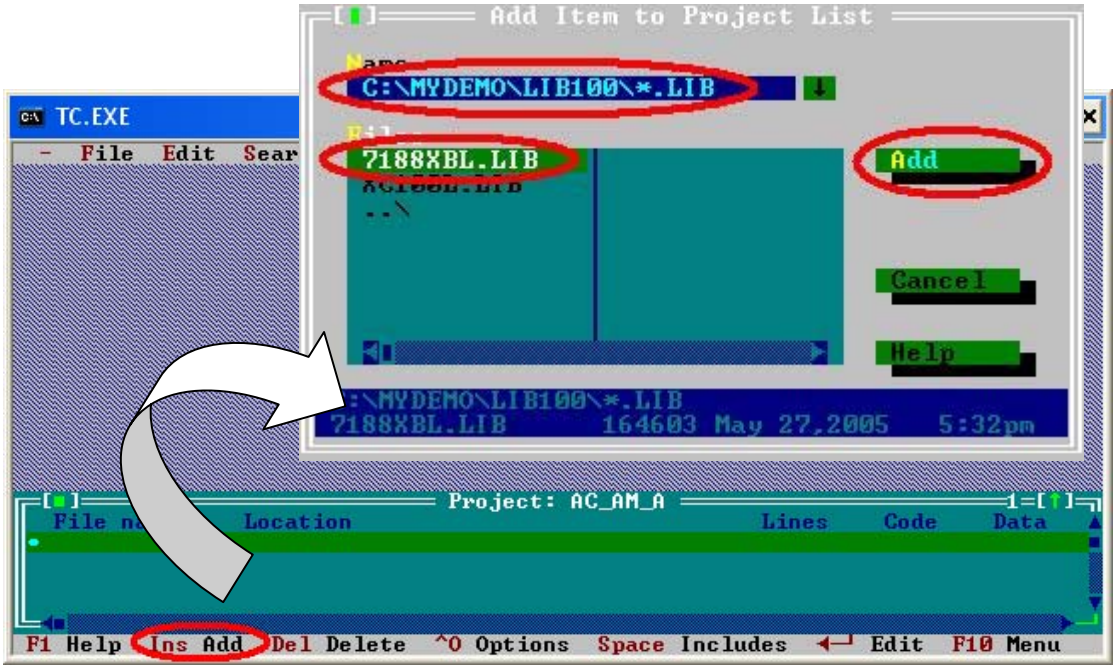
http://community.borland.com/museum



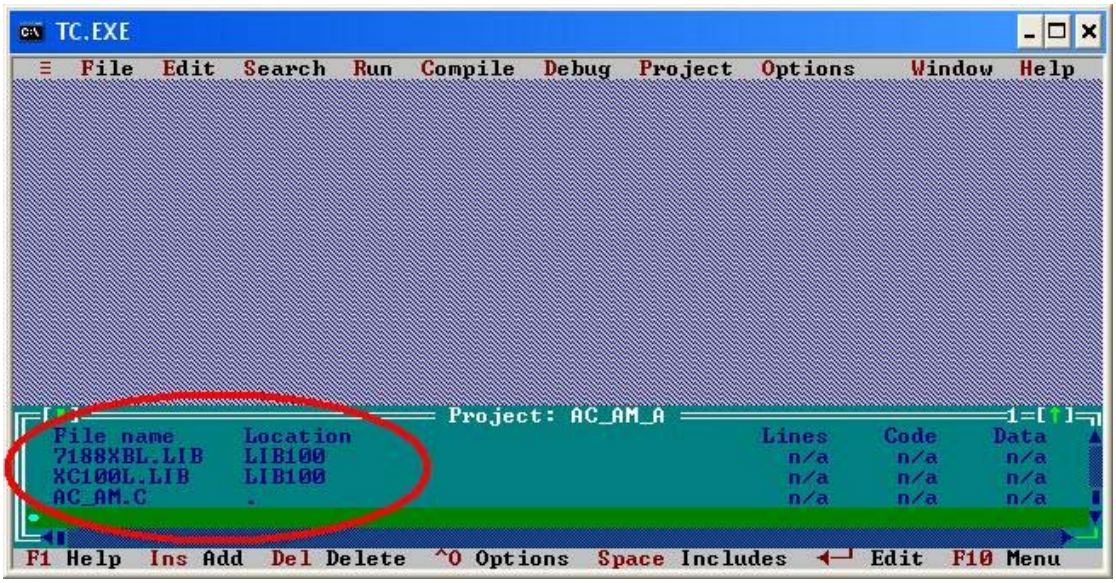
Step4: Click the “Project\Open project…” to create a new project named “AC_AM.PRJ”.



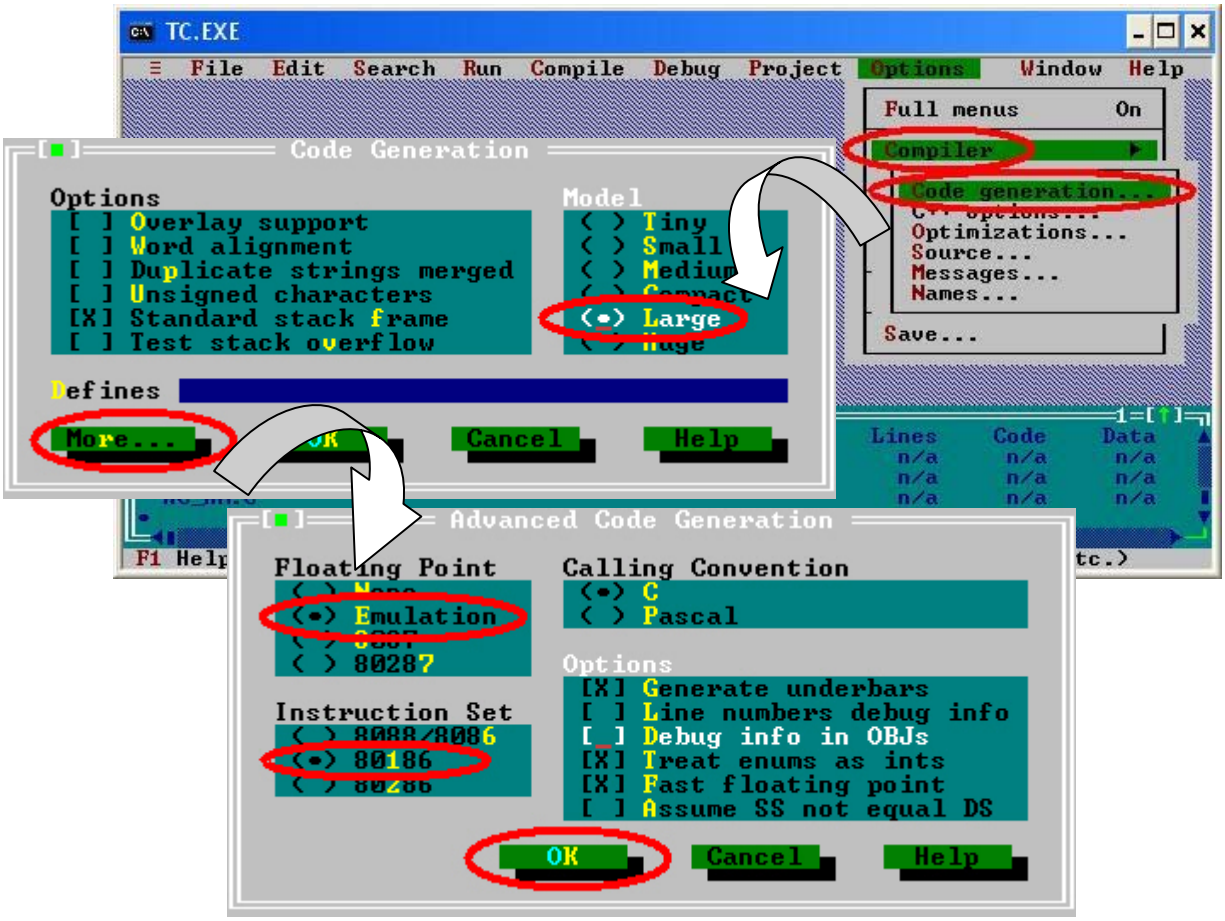
Step5: Search all library file by setting *.lib in the Name filed. Then, use the Add function to add the library file “XC100L.lib” into MyDemo project.



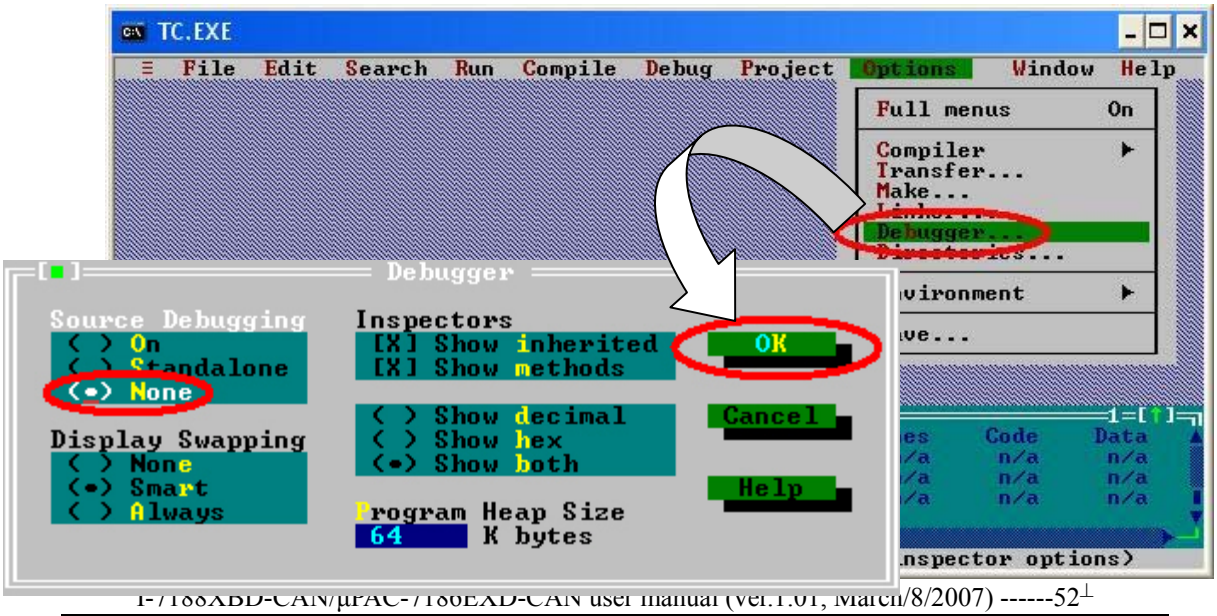
Step6: Following the step5 to add another two files. The one is “7188XBL.lib” because this demo will be run on the I-7188XBD-CAN. If the users use the µPAC-7186EXD-CAN, the library file is “7186EL.lib”. Another one is users’ C source code file. Here, use the file AC_AM.c.


TC.EXE
File Edit Search Run Compile Debug Project Options Window Help
Project: AC_AM.A
File name Location Lines Code Data
7188XBL.LIB LIB100 n/a n/a n/a
XC100L.LIB LIB100 n/a n/a n/a
AC_AM.C . n/a n/a n/a
F1 Help Ins Add Del Delete ^O Options Space Includes Edit F10 Menu

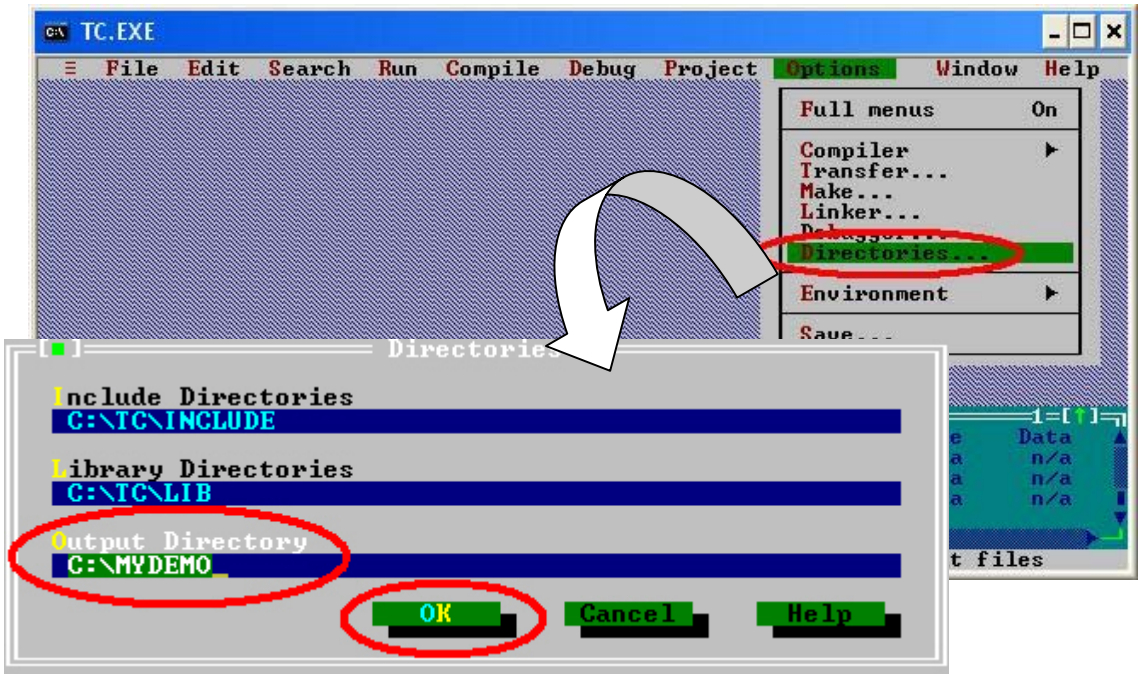
Step7: Click the “Options/Compiler/Code generation…” to set the compile mode to the large mode. Afterwards, click “More…” to set the “Floating point” and “Instruction Set” parameters, the Emulation and 80186 will be used respectively. Then, click OK to save the configuration.



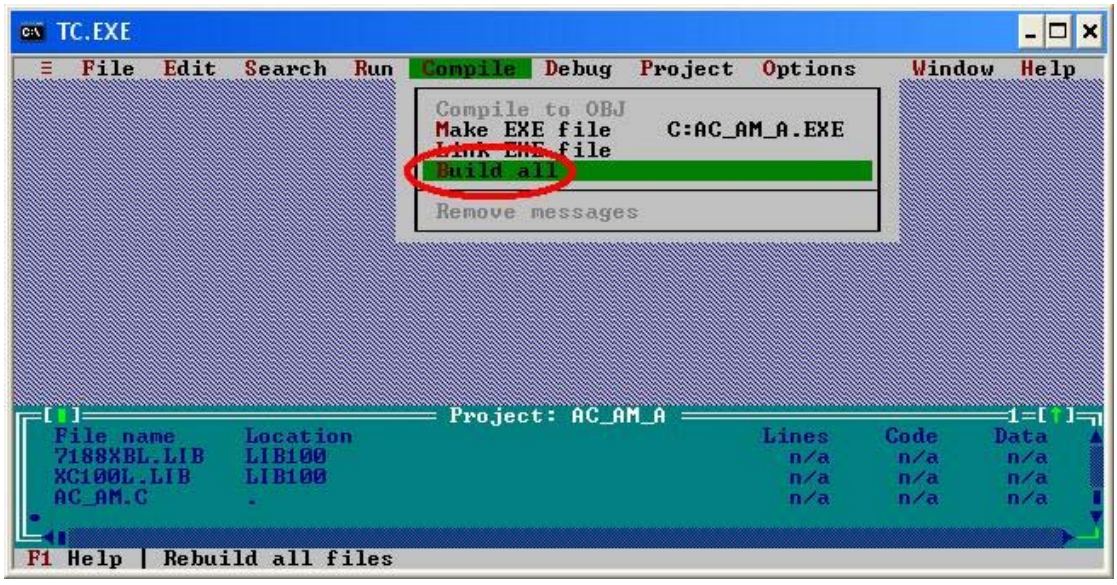
Step8: Click the “Option/Debugger...” to set the “Source Debugging” parameter. Here, select the “None” for the “Source Debugging” parameter.



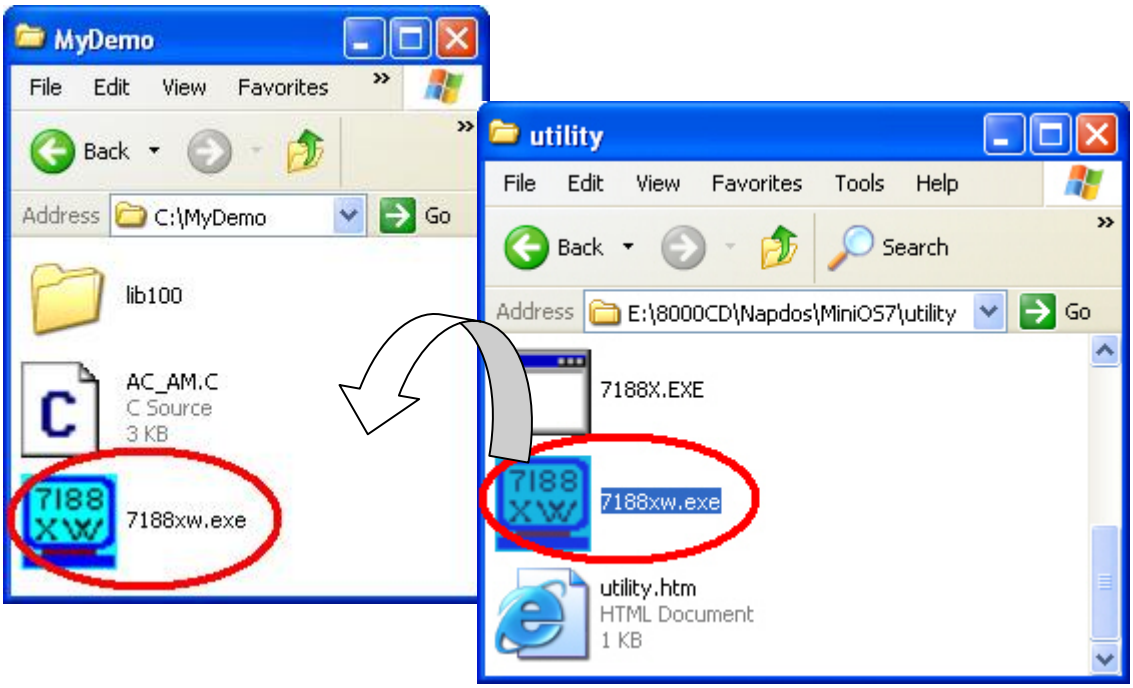
Step9: Click the “Option/Directories...” to set the “Output Directory” parameter. Here, set the “C:\MyDemo” for the “Output Directory” parameter.



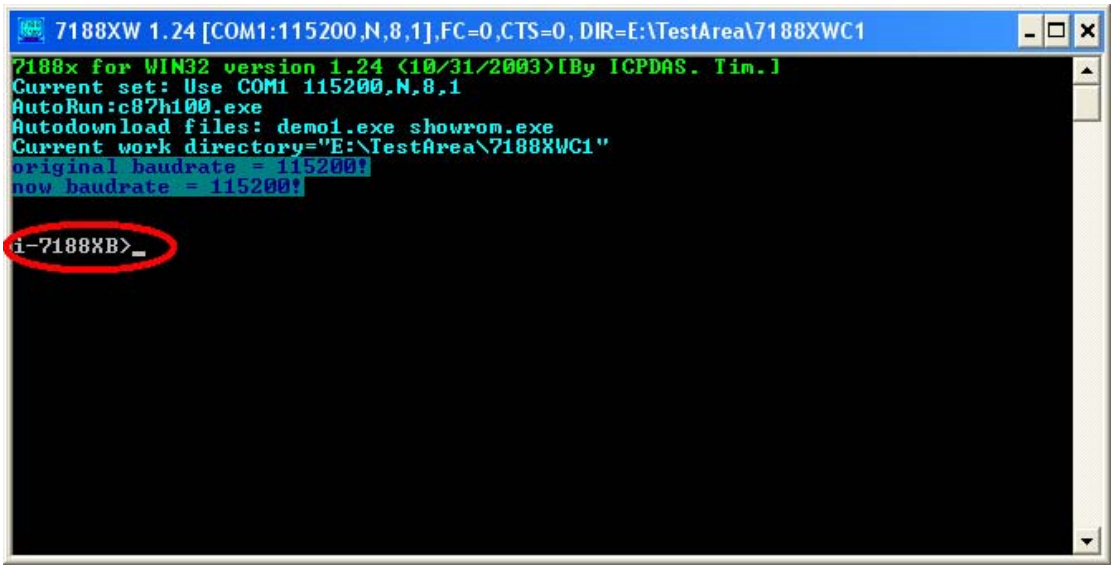
Step10: After finishing all the parameters setting, click the “Compile/build all” to produce the execution file named “AC_AM.exe”. If users use the AC_AM.c, the program (#include “..\lib\7188xbl.lib” and #include “..\lib\xc100l.lib”) need do modify to (#include “.\lib\7188xbl.lib” and #include “.\lib\xc100l.lib”).


TC.EXE
File Edit Search Run Compile Debug Project Options Window Help
Compile to OBJ
Make EXE file C:AC_AM_A.EXE
Link EXE file
Build all
Remove messages
Project: AC_AM_A
File name Location Lines Code Data
7188XBL.LIB LIB100 n/a n/a n/a
XC100L.LIB LIB100 n/a n/a n/a
AC_AM.C . n/a n/a n/a
F1 Help | Rebuild all files

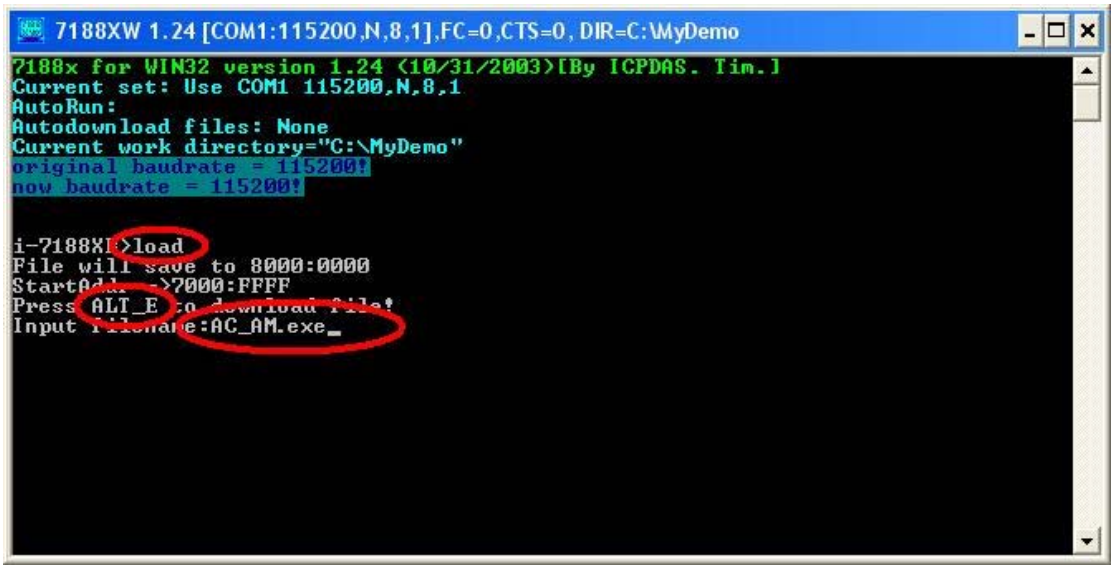
Step11: Copy the file 7188xw.exe into the MyDemo folder. Then, click the 7188xw to run it. The 7188xw can be found in the CD, and the file path is “8000cd\Napdos\MiniOS7\utility”.



Step12: If the COM1 I-7188XBD-CAN is connected to the PC COM1, the hint sign,”I-7188XB>”, will be shown in the 7188xw.exe window after pressing the Enter key in the 7188xw.exe program. If users use µPAC-7186EXD-CAN COM1 to connect the PC COM1, the hint sign, “I7186EX”, will be shown.



Step13: Key the command, “load” in the 7188xw.exe program. Then, follow the hint command to press “Alt+E” and input the file name, “AC_AM.exe “, to download the execution file.



Step14: After finishing the download procedure, key in the command, “run”, to implement the execution file,”AC_AM.exe”.